Stop D
Drake
(Mountain Valleys)

Directions: *Continue eastward along the highway (Devils Gulch Road) beside the North Fork of the Big Thompson River for about 7.2 miles to the town of Drake at the junction with Highway 34, which is also the confluence of the North Fork and the Big Thompson River.*

Mountain Valleys

People travel and congregate in mountain valleys for reasons of efficiency and aesthetics. If you want to go west from Drake (6,200 feet altitude) to Estes Park (7,500 feet altitude), you could choose the shortest distance along a straight line, but you would have to climb up and down several ridges at altitudes of more than 8,000 feet along the way. However, if you follow the Big Thompson River, the climb is far gentler—just a steady incline up to Lake Estes—but the route is about 20 percent longer.

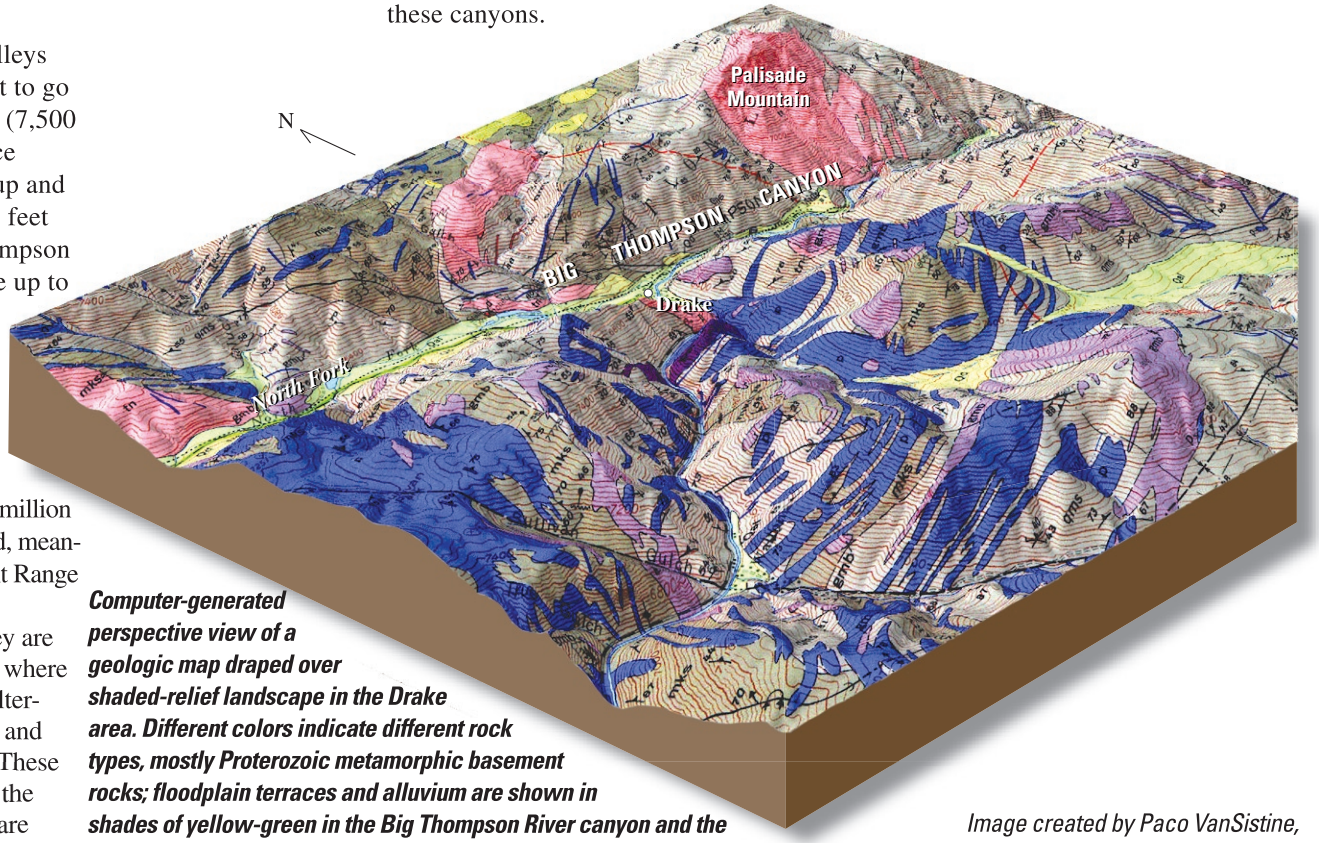
In the Front Range, mountain valleys connect the High Plains (at roughly 5,500 feet altitude) with the upper remnants of an old upland erosion surface (at about 9,000 feet altitude). The rivers and streams carved and eroded the valleys downward from that surface as the mountains were uplifted over the past 15 million years. The numerous deep canyons and their entrenched, meandering routes are evidence of renewed uplift of the Front Range in the last several million years.

Flowing streams follow stable courses where they are hemmed in by rock outcrops on both sides. However, where the valley floor contains much sediment, the stream alternately cuts and fills from side to side by moving sand and gravel that are temporarily stored in terrace deposits. These flat terrace surfaces are attractive building sites along the river—but now and again, we are reminded that they are temporary features subject to change during floods.

Flood Hazard in Mountain Valleys

Water in the Big Thompson River is typically clear because it carries a small load of suspended sediment. As a general rule, most mountain streams don't move much sediment—except during floods. The power of water to move sediment rises quickly as the velocity and discharge (the amount of water passing a fixed point) increase—that's why more sediment gets moved during high flow (flood) conditions. Many things that stand in the floodwater's way may also get moved—large boulders, trees, cars, houses, bridges, and roads.

Mountain rainfall in Colorado is most intense between 7,000 feet and 9,500 feet altitude, because that's typically where rising, cooling air becomes saturated and moisture condenses to rain. By a coincidence of geography, the zone of greatest expected rainfall is at the tops of the deep, narrow canyon stretches of the mountain valleys. Occasional floods will always be a fact of life in these canyons.



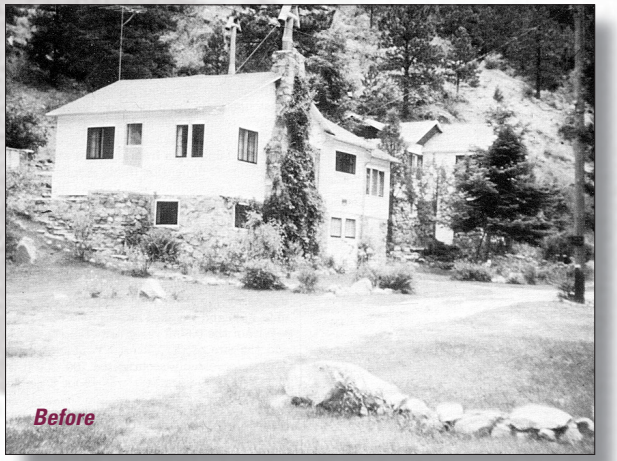
Computer-generated perspective view of a geologic map draped over shaded-relief landscape in the Drake area. Different colors indicate different rock types, mostly Proterozoic metamorphic basement rocks; floodplain terraces and alluvium are shown in shades of yellow-green in the Big Thompson River canyon and the canyon of North Fork. One inch equals approximately one mile.

Image created by Paco VanSistine, U.S. Geological Survey.

The Big Thompson Flood

On July 31, 1976, about 7.5 inches of rain fell on the upper Big Thompson River drainage in about an hour in the early evening. The exceptionally heavy rainfall was caused by a very powerful and stationary thunderstorm. All this water moved down the narrow canyon at about 20-25 feet per second (15 miles per hour), scouring the river channel and moving boulders and debris along the channel sides. Many bridges were lost, riverside houses were swept away, and intense erosion took place along all outside bends of the river. The floodwaters caught travelers and residents unaware, and 139 people died in the canyon (five people were reported missing and remain so today).

Official evaluations following the tragic event determined that many deaths in the canyon could have been avoided. Many who died probably could have survived if they had abandoned their vehicles and climbed to safety. It has been many years since clean-up and reconstruction in the canyon, and vegetation has regrown—the geologic effects of the flood are now hard to see. Roadside warning signs ("CLIMB TO SAFETY! IN CASE OF A FLASH FLOOD") are some of the few visual reminders of this major flood.



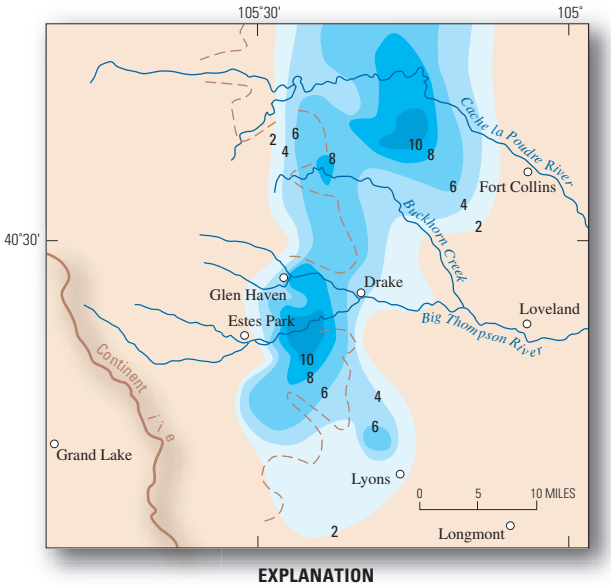
Ground-level photographs of the same Drake house before and after the flood show numerous large boulders deposited during the 1976 event. Comparative photograph from 2004 shows that flood effects are almost invisible after less than 30 years. *Black and white images from U.S. Geological Survey (1979).*

July 31, 1976, photograph of large thundercloud over the Big Thompson drainage. *Image from U.S. Geological Survey (1979).*

What Is a Hundred-Year Flood?

Simply stated, a hundred-year flood is any flow (discharge) that has one chance in 100 of being exceeded in any given year. It is only a statistical measure, just as the probability that a flipped coin will land heads-up is 1 in 2. If the coin comes up heads five times in a row, the probability that it will be heads again on the sixth try is still 1 in 2. In the same way, a hundred-year flood is just as likely (and just as unlikely) the next year following a flood event as it is 50 years later, 100 years later, or 150 years later.

The Big Thompson flood of 1976 exceeded the 100-year-event probability wherever gaging records were available. The discharge was almost two times greater than the estimated 100-year flow at the canyon mouth, but was even more unusually high (four times greater) in the upper part of the canyon. The flows from this event, although large, were not nearly as great as previous major rainstorms that affected the foothills and eastern plains in 1935 and 1965.



Sketch map showing measured and estimated total rainfall for the overnight storm of July 31–August 1, 1976. Highest rainfall amounts occurred near 8,000 feet altitude or lower. *Adapted from U.S. Geological Survey (1979).*

(Right) ***Warning signs were installed in most Colorado canyons following the Big Thompson flood.***

(Below) ***Aerial photographs taken before and immediately after the flood show the extent of change in the floodplain.*** *Images from U.S. Geological Survey (1979).*